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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The final report for the project, Mathematical Software for Linear Control and Estimation Theory includes a list of publications, conference proceedings, and invited talks by the principal investigators. Emphasis throughout the project was placed on interdisciplinary work in control theory, numerical methods suitable for certain control problems and mathematical software to do the frequency response problem. Numerically stable methods were used, and portability of the mathematical software was stressed.

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FINAL REPORT: Mathematical Software for Linear Control and Estimation Theory
by Virginia Klema

The research emphasized the use of numerically stable methods for linear control and estimation theory with emphasis on mathematical software for a most frequently encountered problem for control systems--the frequency response problem. The work represented interdisciplinary research on control and estimation and numerical linear algebra with emphasis on problems for which there is sufficient definition and use to warrant the research and design of mathematical software that is portable across many different kinds of computing machines.

During this period of research several papers were published in journals widely read by the control systems community. These papers have been listed in progress reports, and reprints have been sent to the U. S. Army Research Office. They are included by title in this report as follows:

"The Singular Value Decomposition: Its Computation and Some Applications," IEEE Trans. Aut. Con., vol. AC-25, 1980.
"On the Numerical Solution of the Discrete Time Algebraic Riccati Equation," IEEE Trans. Aut. Con., vol. AD-25, 1980.
"Further Comments on the Numerical Solution of the Discrete Time Algebraic Riccati Equation," IEEE Trans. Aut. Con., vol AC-25, 1980.
"On Computing Balancing Transformations," Proc. 1980 Joint Auto. Con. Conf., 1980.
"Efficient Multivariable Frequency Response Calculations," IEEE CDC, 1980.
"Solution of Discrete Time LQG Problems with Singular Transition Matrix," IEEE CDC, 1979.

The senior scientific personnel supported by this project, Virginia Klema and Alan Laub each presented invited lectures at the Workshop on Numerical Methods in Control held in Lund, Sweden, September, 1980.

Research during this two year period of time indicates that a great deal of work needs to be done to expose in an effective manner the condition of the eigen problem for nonsymmetric matrices and the problem AX + XB = C. The nearness of a matrix to a defective matrix needs to be assessed for models of control systems. The much used Kalman filter problem needs mathematical software that permits varying statistical assumptions and takes advantage of the block structure of matrices.